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**Academic Regulations 2009 for B. Tech (Regular)**
(Effective for the students admitted into I year
from the Academic Year 2009-2010 onwards)

**1. Award of B.Tech. Degree**

A student will be declared eligible for the award of the B.Tech. Degree if he fulfils the following academic regulations:

**i.** Pursue a course of study for not less than four academic years and in not more than eight academic years.

**ii.** Register for 220 credits and secure all 220credits

**2.** Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech course and their admission is cancelled.

**3. Courses of study**

The courses of study are offered at present for specialization for the B. Tech. Course:

| S.No. | Branch |
|---|---|
| 1. | Aeronautical Engineering. |
| 2. | Biotechnology. |
| 3. | Civil Engineering. |
| 4. | Computer Science and Engineering. |
| 5. | Computer Science and System Engineering. |
| 6. | Electrical and Electronics Engineering. |
| 7. | Electronics and Communication Engineering. |
| 8. | Electronics and Computer Engineering. |
| 9. | Electronics and Control Engineering. |
| 10. | Electronics and Instrumentation Engineering. |
| 11. | Information Technology. |
| 12. | Mechanical Engineering. |

and any other course as approved by the authorities of the University from time to time.



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**4. Credits**

| | I Year | | Semester | |
|---|---|---|---|---|
| | Periods / Week | Credits | Periods / Week | Credits |
| Theory | 03 | 06 | 03 | 04 |
| | 02 | 04 | -- | -- |
| Practical | 03 | 04 | 03 | 02 |
| Drawing | 06 | 06 | 03<br>06 | 02<br>04 |
| Seminar | -- | -- | 6 | 02 |
| Project | -- | -- | 15 | 10 |

**5. Distribution and Weightage of Marks**

i. The performance of a student in each semester / I year shall be evaluated subject –wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition seminar and project work shall be evaluated for 50 and 200 marks respectively.

ii. For theory subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.

iii. For theory subjects, during the semester there shall be Two midterm examinations. Each mid term examination consists of objective paper for 10 marks and subjective paper for 20 marks with duration of 1hour 50 minutes (20 minutes for objective and 90 minutes for subjective paper).

Objective paper is set for 20 bits for 10 marks. Subjective paper shall contain 5 questions of which student has to answer 3 questions evaluated* for 20 marks. First mid term examination shall be conducted for I-IV units of syllabus and second mid term examination shall be conducted for V -VIII units. The total marks secured by the student in each mid term examination for 30 marks is considered and the better of the two mid term examinations shall be taken as the final sessional marks secured by each candidate in the subject.

However for first year, there shall be Three midterm examinations as in the above pattern and the average marks of the best two midterm examinations secured in each subject shall be considered as final marks for sessionals.



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*Note 1: The subjective paper shall contain 5 questions of equal weightage of 10 marks and the marks obtained for 3questions shall be condensed to 20 marks, any fraction rounded off to the next higher mark

*Note 2: The mid term examination shall be conducted first by distribution of the Objective paper simultaneously marking the attendance, after 20minutes the answered objective paper is collected back. The student is not allowed to leave the examination hall. Then the descriptive question paper and the answer booklet are distributed. After 90minutes the answered booklets are collected back.

iv. For practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 end examination marks. Day-to-day work in the laboratory shall be evaluated for 25 marks by the concerned laboratory teacher based on the report of experiments/jobs. The end examination shall be conducted by the laboratory teacher and another examiner.

v. For the subject having design and / or drawing, such as Engineering Drawing, Machine Drawing and estimation, the distribution shall be 30 marks for internal evaluation and 70 marks for end examination. The Internal evaluation for sessionals will be 15 marks for day-to-day work in the class that shall be evaluated by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm exams in a Semester for a duration of 2hrs each, evenly distributed over the syllabi for 15 marks and the better of the two shall be considered as internal test marks. The sum of day to day evaluation and the internal test marks will be the final sessionals for the subject. However in the I year class, there shall be three midterm exams and the average of best two will be taken into consideration.

vi. There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the department before presentation. The report and the presentation shall be evaluated by the Departmental committee consisting of Head of the department, seminar supervisor and a senior faculty member. The



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seminar shall be evaluated for 50 marks and marks shall be submitted to the University along with internal marks. There shall be no external examination for seminar.

vii. Out of a total of 200 marks for the project work, 60 marks shall be for Internal Evaluation and 140 marks for the End Semester Examination (Viva-voce). The viva-voce shall be conducted by a committee consisting of HOD, Project Supervisor and an External Examiner nominated by the University. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be made by the departmental committee, on the basis of two seminars given by each student on the topic of his project.

viii. Laboratory marks and the sessional marks awarded by the College are not final. They are subject to scrutiny and scaling by the University wherever necessary. In such cases, the sessional and laboratory marks awarded by the College will be referred to a Committee. The Committee will arrive at a scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding.

ix. The laboratory records and internal test papers shall be preserved in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

**6. Attendance Requirements:**

i. A student shall be eligible to appear for University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester/ I year.

ii. **Shortage of Attendance below 65% in aggregate shall in <u>NO</u> case be condoned**.

iii. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or I year may be granted by the College Academic Committee.

iv. Students whose shortage of attendance is not condoned in any semester / I year are not eligible to take their end examination of that class and their registration shall stand cancelled.

v. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester / I



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year, as applicable. They may seek readmission for that semester / I year when offered next.

vi. A stipulated fee shall be payable towards condonation of shortage of attendance to the University.

**7. Minimum Academic Requirements:**

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.**6**

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together. In the Seminar he should secure 40%.

ii. A student shall be promoted from II to III year only if he fulfils the academic requirement of securing **40** credits from

a. One regular and one supplementary examinations of I year.
b. One regular examination of II year I semester

irrespective of whether the candidate takes the end examination or not as per the normal course of study.

iii. A student shall be promoted from third year to fourth year only if he fulfils the academic requirements of securing **68 c**redits from the following examinations,

a. Two regular and two supplementary examinations of I year.
b. Two regular and one supplementary examinations of II year I semester.
c. One regular and one supplementary examinations of II year II semester.
d. One regular examination of III year I semester.

irrespective of whether the candidate takes the end examination or not as per the normal course of study.

And in case of getting detained for want of credits by sections ii and iii above, the student may make up the credits through supplementary exams of the above exams before the date of class work commencement of Third or Fourth year I semester respectively.



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iv. A student shall register and put up minimum attendance in all 220 credits and earn all the 220 credits. Marks obtained in all 220 credits shall be considered for the calculation of percentage of marks obtained.

v. Students who fail to earn 220 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in B.Tech course and their admission shall stand cancelled.

**8. Course pattern:**

i. The entire course of study is of four academic years. The first year shall be on yearly pattern and the second, third and fourth years on semester pattern.

ii. A student eligible to appear for the end examination in a subject, but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii. When a student is detained due to lack of credits / shortage of attendance he may be re-admitted when the semester is offered after fulfilment of academic regulations, whereas he continues to be in the academic regulations he was first admitted.

**9. Transitory Regulations:**

Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section **2**. and they continues to be in the academic regulations they were first admitted.

**10. With–holding of results**:

If the candidate has any dues not paid to the university or if any case of indiscipline or malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.



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**11. Award of Class:**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

| Class Awarded | % of marks to be secured | |
|---|---|---|
| First Class with Distinction | 70% and above | From the aggregate marks secured for the best 220 Credits. |
| First Class | Below 70% but not less than 60% | |
| Second Class | Below 60% but not less than 50% | |
| Pass Class | Below 50% but not less than 40% | |

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

**12. Minimum Instruction Days:**

The minimum instruction days including exams for each semester / I year shall be 90/180 days respectively.

**13.** There shall be no branch transfers after the completion of admission process.

**14.** There shall be no place transfer within the Constituent Colleges.

**15. General:**

i. **The academic regulations should be read as a whole for purpose of any interpretation**.
ii. **Malpractices rules- nature and punishments is appended**
iii. **Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".**
iv. **In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.**
v. **The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on roles with effect from the dates notified by the University.**

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## ACADEMIC REGULATIONS FOR B. TECH. (LATERAL ENTRY SCHEME)

(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year 2010-2011 and onwards)

**1. Award of B.Tech. Degree**

A student admitted in LES will be declared eligible for the award of the B. Tech Degree if he fulfils the following academic regulations:

i. Pursue a course of study for not less than three academic years and in not more than six academic years.

ii. Register for 168 credits and secure all 168 credits from II to IV year of Regular B.Tech. program

**2.** Students, who fail to fulfil the requirement for the award of the degree in six consecutive academic years from the year of admission, shall forfeit their seat.

**3.** The regulations **3** to **6** are to be adopted as that of B. Tech. (Regular).

**7. Minimum Academic Requirements :**

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.**6**

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together. For the Seminar he should secure 40% in the internal evaluation.

ii. A student shall be promoted from third year to fourth year only if he fulfils the academic requirements of 42 credits from the following examinations.

a. Two regular and one supplementary examinations of II year I semester.

b. One regular and one supplementary examinations of II year II semester.

c. One regular examination of III year I semester.

irrespective of whether the candidate takes the end examination or not as per the normal course of study.

and in case of getting detained for want of credits the student may make up the credits through supplementary exams of the above



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exams before the date of class work commencement of Fourth year I semester.

**8. Course Pattern**

i. The entire course of study is three academic years on semester pattern.

ii. A student eligible to appear for the end examination in a subject, but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii. When a student is detained due to lack of credits / shortage of attendance he may be re-admitted when the semester is offered after fulfilment of academic regulations, whereas he continues to be in the academic regulations he was first admitted.

**9.** The regulations **9** to **10** are to be adopted as that of B. Tech. (Regular).

**11. Award of Class:**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

| | | |
|---|---|---|
| First Class with Distinction | 70% and above | From the aggregate marks secured for 168 Credits. (i.e. II year to IV year) |
| First Class | Below 70% but not less than 60% | |
| Second Class | Below 60% but not less than 50% | |
| Pass Class | Below 50% but not less than 40% | |

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

**12**.The regulations **12** to **15** are to be adopted as that of B. Tech. (Regular). All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)



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## RULES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

| | Nature of Malpractices/Improper conduct | Punishment |
|---|---|---|
| | *If the candidate:* | |
| 1. (a) | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| (b) | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him. |
| 2. | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including |



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| | | |
|---|---|---|
| | practical) in which the candidate is appearing. | practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University. |
| 3. | Impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. |
| 4. | Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question | Expulsion from the examination hall and cancellation of performance in |



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| | | |
|---|---|---|
| | paper during the examination or answer book or additional sheet, during or after the examination. | that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5. | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that subject. |
| 6. | Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police |



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| | | |
|---|---|---|
| | assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | and a police case is registered against them. |
| 7. | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 8. | Possess any lethal weapon or firearm in the examination hall. | Expulsion from the examination hall and cancellation of the |



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| | | |
|---|---|---|
| | | performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. |
| 9. | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. |
| 10. | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and |



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| | | |
|---|---|---|
| | | project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. |
| 11. | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations. |
| 12. | If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment. | |

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)

(i) A show cause notice shall be issued to the college.

(ii) Impose a suitable fine on the college.

Shifting the examination centre from the college to another college for a specific period of not less than one year.

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# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**III Year B.Tech I-Sem**

| Sl. No | Course Code | Subject | L | | P | Credits |
|---|---|---|---|---|---|---|
| 1. | 9AHS401 | Managerial Economics and Financial Analysis | 4 | | | 4 |
| 2. | 9A02501 | Electrical & Electronic Measurements | 4 | | | 4 |
| 3. | 9A02502 | Transmission of Electric Power | 4 | | | 4 |
| 4. | 9A02503 | Control Systems | 4 | | | 4 |
| 5. | 9A02504 | Power Electronics | 4 | | | 4 |
| 6. | 9A02505 | Electrical Machines – III | 4 | | | 4 |
| 7. | 9A02506 | Electrical Machines Lab – II | | | 3 | 2 |
| 8. | 9A02507 | Control Systems and Simulation Lab | | | 3 | 2 |
| | | contact period / week | 24 | | 6 | |
| | | | Total/Week 30 | | | |
| Total Credits (6 Theory + 2 Labs) | | | | | | 28 |



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**JAWAHARLAL NEHRU**
**TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**III Year B.Tech II-Sem**

| Sl. No | Course Code | Subject | L | | P | Credits |
|---|---|---|---|---|---|---|
| 1. | 9AHS701 | Management Science | 4 | | | 4 |
| 2. | 9A02601 | Power Semiconductor Drives | 4 | | | 4 |
| 3. | 9A02602 | Power System Analysis | 4 | | | 4 |
| 4. | 9A04602 | Microprocessors and Microcontrollers | 4 | | | 4 |
| 5. | 9A02603 | Power System Operation and Control | 4 | | | 4 |
| 6. | 9A10504 | Linear & Digital IC Applications | 4 | | | 4 |
| 7. | 9AHS601 | Advanced English Communication Skills Lab | | | 3 | 2 |
| 8. | 9A02604 | Electrical Measurements Lab | | | 3 | 2 |
| | | contact period / week | 24 | | 6 | |
| | | | Total/Week 30 | | | |
| Total Credits (6 Theory + 2 Labs) | | | | | | 28 |



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**JAWAHARLAL NEHRU**
**TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**IV Year B.Tech I-Sem**

| Sl. No | Course Code | Subject | L | | P | Credits |
|---|---|---|---|---|---|---|
| 1. | 9A02701 | Distribution of Electric Power | 4 | | | 4 |
| 2. | 9A04603 | Digital Signal Processing | 4 | | | 4 |
| 3. | 9A02702 | Fundamentals of HVDC & FACTS Devices | 4 | | | 4 |
| 4. | 9A02703 | Switch Gear and Protection | 4 | | | 4 |
| 5. | 9A02704<br>9A02705<br>9A02706 | **ELECTIVE - I**<br>1. Instrumentation<br>2. High Voltage Engineering<br>3. Renewable Energy Sources | 4 | | | 4 |
| 6. | 9A02707<br>9A02708<br>9A02709 | **ELECTIVE – II**<br>1. Soft Computing Techniques<br>2. Reliability Engineering and Applications to Power Systems<br>3. Optimization Techniques | 4 | | | 4 |
| 7. | 9A02710 | Microprocessors and microcontrollers lab | | | 3 | 2 |
| 8. | 9A02711 | Power Electronics and Simulation Lab | | | 3 | 2 |
| | | Contact period / week | 24 | | 6 | |
| | | | Total/Week 30 | | | |
| Total Credits (6 Theory + 2 Labs) | | | | | | 28 |



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**IV Year B.Tech II-Sem**

| Sl.No | Course Code | Subject | L | | P | Credits |
|---|---|---|---|---|---|---|
| 1. | 9A02801 | Principles of Power Quality | 4 | | | 4 |
| 2. | 9A02802 | Utilization Of Electrical Energy | 4 | | | 4 |
| 3. | 9A02803<br>9A02804<br>9A02805 | **ELECTIVE – III**<br>1. Modern Control Theory<br>2. Special Electrical Machines<br>3.Plc & Dcs - Its Applications | 4 | | | 4 |
| 4. | 9A02806<br>9A02807<br>9A02808 | **ELECTIVE – IV**<br>1. Embedded Systems<br>2. Design of Electrical Systems<br>3. Energy Auditing & Demand Side Management | 4 | | | 4 |
| 5. | 9A02809 | Seminar | | | | 2 |
| 6. | 9A02810 | Project | | | | 10 |
| | | contact period / week | 16 | | | |
| | | | Total/Week 16 | | | |
| Total Credits (4 Theory + Seminar + Project work) | | | | | | 28 |



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

| **B.Tech III-I Sem. (E.E.E)** | **T** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **4** |

## (9AHS401) MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS
**(Common to BOT, CE, ECM, EEE, ME)**

**UNIT I: INTRODUCTION TO MANAGERIAL ECONOMICS**
Definition, nature and scope of managerial economics- relation with other disciplines- Demand Analysis: Demand Determinants, Law of Demand and its exceptions

**UNIT II**: **ELASTICITY OF DEMAND**
Definition, Types, Measurement and Significance of Elasticity of Demand. Demand forecasting, factors governing demand forecasting, methods of demand forecasting (Survey methods, Statistical methods, Expert opinion method, Test marketing, Controlled experiments, Judgmental approach to Demand Forecasting)

**UNIT III :THEORY OF PRODUCTION AND COST ANALYSIS**
Production Function – Isoquants and Isocosts, MRTS, least cost combination of inputs, Cobb-Douglas production function, laws of returns, internal and external economies of scale.
**Cost Analysis**: Cost concepts, opportunity cost, fixed Vs variable costs, explicit costs Vs Implicit costs, out of pocket costs Vs Imputed costs. Break-Even Analysis (BEA) - Determination of Break Even Point (Simple Problems)- Managerial significance and limitations of BEA.

**UNIT IV: INTRODUCTION TO MARKETS AND PRICING POLICIES**
Market structures: Types of competition, features of perfect competition, monopoly- monopolistic competition. Price-Output determination under perfect competition and monopoly - Methods of Pricing-cost plus pricing, marginal cost, limit pricing, skimming pricing, bundling pricing, sealed bid pricing and peak load pricing.



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**UNIT V: BUSINESS ORGANISATIONS AND NEW ECONOMIC ENVIRONMENT**

Characteristic features of business, features and evaluation of sole proprietorship, partnership, Joint Stock Company, public enterprises and their types, changing business environment in post-liberalization scenario.

**UNIT VI: CAPITAL AND CAPITAL BUDGETING**

Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising finance.

Nature and scope of capital budgeting, features of capital budgeting proposal, methods of capital budgeting – payback method, accounting rate of return (ARR) and Net present value method (Simple problems).

**UNIT VII: INTRODUCTION TO FINANCIAL ACCOUNTING**

Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

**UNIT VIII: FINANCIAL ANALYSIS THROUGH RATIOS**

Computation, Analysis and Interpretation of financial statements through Liquidity Ratios (Current and Quick ratio), Activity ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt- Equity Ratio, Interest Coverage Ratio) and Profitability ratios (Gross Profit Ratio, Net Profit Ratio, Operating Ratio, P/E Ratios and EPS), Du Pont Chart.

**TEXT BOOKS:**

1. Aryasri: Managerial Economics and Financial Analysis, 4/e, TMH, 2009.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.

**REFERENCES**

1. Premchand Babu, Madan Mohan:Financial Accounting and Analysis,Himalaya, 2009
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International,. 2009.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.



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4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2009.
5. H.L.Ahuja: Managerial Economics, S.Chand, 3/e, 2009



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## (9A02501) ELECTRICAL & ELECTRONIC MEASUREMENTS

**Objective :**
Electrical measurements course introduces the basic principles of all measuring instruments. It also deals with the measurement of RLC parameters voltage, current Power factor, power, energy and magnetic measurements and Digital Meters

**UNIT-I MEASURING INSTRUMENTS**
Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, Dynamometer, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance.

**UNIT –II INSTRUMENT TRANSFORMERS AND P.F METER**
CT and PT – Ratio and phase angle errors – design considerations. Types of P.F. Meters – dynamometer and moving iron type – 1-ph and 3-ph meters.

**UNIT –III MEASUREMENT OF POWER / ENERGY**
Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques. Single phase induction type energy meter – driving and braking torques – errors and compensations. Three phase energy meter.

**UNIT –I V POTENTIOMETERS**
Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate types standardization – applications.

**UNIT – V D.C & A.C BRIDGES**
Method of measuring low, medium and high resistance – sensitivity of Wheatstone's bridge – Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance - Maxwell's bridge, Anderson's bridge.



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Measurement of capacitance and loss angle - Desauty bridge. Wien's bridge – Schering Bridge.

**UNIT – VI MAGNETIC MEASUREMENTS**

Ballistic galvanometer – equation of motion – flux meter – constructional details, comparison with ballistic galvanometer. Determination of B-H Loop methods of reversals - six point method – A.C. testing – Iron loss of bar samples.

**UNIT – VII OSCILLOSCOPE**

Cathode Ray Oscilloscope- Cathode Ray tube-Time base generator- Horizontal and Vertical amplifiers – application of CRO – Measurement of phase , frequency, current & voltage- Lissajous pattern

**UNIT – VIII DIGITAL METERS**

Digital Voltmeter-Successive approximation, ramp and integrating type-Digital frequency meter-Digital multimeter-Digital Tachometer

**TEXT BOOK:**

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, 5th Edition, Reem Publications.
2. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications.
3. Electrical & Electronic Measurement & Instrumentation by R. K. Rajput, 2nd Edition, S. Chand & Co.
4. Electronic Instrumentation by H. S. Kalsi, Tata Grawhill Mc, 3rd Edition.

**REFERENCE BOOKS:**

1. Electrical Measurements – by Buckingham and Price, Prentice – Hall
2. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.



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## (9A02502) TRANSMISSION OF ELECTRIC POWER

**Objective :**

This course is an extension of Power systems-I course. It deals with basic theory of transmission lines modeling and their performance analysis. Also this course gives emphasis on mechanical design of transmission lines, cables and insulators.

### UNIT-I TRANSMISSION LINE PARAMETERS

Types of conductors - calculation of resistance for solid conductors - Calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition, Numerical Problems.

Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, Numerical Problems.

### UNIT-II PERFORMANCE OF SHORT AND MEDIUM TRANSMISSION LINES

Classification of Transmission Lines - Short, medium and long line and their model - representations - Nominal-T, Nominal-Pie and A, B, C, D Constants. Numerical Problems. Mathematical Solutions to estimate regulation and efficiency of all types of lines - Numerical Problems.

### UNIT-III PERFORMANCE OF LONG TRANSMISSION LINES

Long Transmission Line-Rigorous Solution, evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations – Representation of Long lines – Equivalent T and Equivalent – $\pi$ – surge Impedance and surge Impedance loading - wavelengths and Velocity of propagation – Ferranti effect , Charging current.



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**UNIT – IV POWER SYSTEM TRANSIENTS**

Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of lines with different types of conditions - Open Circuited Line, Short Circuited Line, T-Junction, Lumped Reactive Junctions (Numerical Problems). Bewley's Lattice Diagrams (for all the cases mentioned with numerical examples).

**UNIT-V CORONA**

Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss, Radio Interference.

**UNIT-VI OVERHEAD LINE INSULATORS**

Types of Insulators, String efficiency and Methods for improvement, Numerical Problems - voltage distribution, calculation of string efficiency, Capacitance grading and Static Shielding.

**UNIT-VII SAG AND TENSION CALCULATIONS**

Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind and Ice on weight of Conductor, Numerical Problems - Stringing chart and sag template and its applications.

**UNIT-VIII UNDERGROUND CABLES**

Types of Cables, Construction, Types of Insulating materials, Calculations of Insulation resistance and stress in insulation, Numerical Problems. Capacitance of Single and 3-Core belted cables, Numerical Problems.

Grading of Cables - Capacitance grading, Numerical Problems, Description of Inter-sheath grading.

**TEXT BOOKS:**

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd.
2. Electrical power systems - by C.L.Wadhwa, New Age International (P) Limited, Publishers,1998.
3. Power System Engineering by R. K. Rajput, Laxmi Publications, 1st Edition.



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**REFERENCE BOOKS:**

1. Power system Analysis-by John J Grainger, William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, S. Chand & Co, 6th Revised Edition, 2010.
3. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2nd Edition.
4. Electric Power Transmission System Engineering: Analysis and Design, by Turan Gonen, 2nd Edition, CRC Press.
5. Electric Power Systems by S. A. Nasar, Schaum's Outline Series, Revised 1st Edition, TMH.



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## (9A02503) CONTROL SYSTEMS

**(Common to EEE, ECE, E Con E, EIE)**

**Objective:**

In this course it is aimed to introduce to the students the principles and applications of control systems in everyday life. The basic concepts of block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain.

**UNIT – I INTRODUCTION**

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions - Translational and Rotational mechanical systems

**UNIT II TRANSFER FUNCTION REPRESENTATION**

Transfer Function of DC Servo motor - AC Servo motor- Synchro transmitter and Receiver -Block diagram algebra –Signal flow graph - Reduction using Mason's gain formula.

**UNIT-III TIME RESPONSE ANALYSIS**

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional, integral, derivative Controls.

**UNIT – IV STABILITY ANALYSIS IN S-DOMAIN**

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.



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**UNIT – V FREQUENCY RESPONSE ANALYSIS**

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

**UNIT – VI STABILITY ANALYSIS IN FREQUENCY DOMAIN**

Polar Plots-Nyquist Plots-Stability Analysis.

**UNIT – VII CLASSICAL CONTROL DESIGN TECHNIQUES**

Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, P, PD, PI, PID Controllers.

**UNIT – VIII STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS**

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties.

**TEXT BOOKS:**

1. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son's, 8th edition, 2003.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007.
3. Control Systems – A. Anand Kumar, Prentice Hall of India Pvt. Ltd.,

**REFERENCE BOOKS:**

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. Control Systems Engineering - by NISE 5th Edition – John wiley.
3. "Modelling & Control Of Dynamic Systems" by Narciso F. Macia George J. Thaler, Thomson Publishers.
4. Modern Control Engineering – by Yaduvir Singh and S. Janardhan, CENGAGE Learning.



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**(9A02504) POWER ELECTRONICS**
**(Common to EEE, E Con E)**

**Objective :**

With the advent of semiconductor devices, revolution is taking place in the power transmission distribution and utilization. This course introduces the basic concepts of power semiconductor devices, converters and choppers and their analysis.

**UNIT – I POWER SEMI CONDUCTOR DEVICES**

Thyristors – Silicon Controlled Rectifiers (SCR's) – BJT – Power MOSFET – Power IGBT and their characteristics and other thyristors – Basic theory of operation of SCR – Static characteristics – Turn on and turn off methods- Dynamic characteristics of SCR - Turn on and Turn off times -Salient points

**UNIT – II DEVICES AND COMMUTATION CIRCUITS**

Two transistor analogy – SCR – R and RC Triggering - UJT firing circuit —– Series and parallel connections of SCR's – Snubber circuit details – Specifications and Ratings of SCR's, BJT, IGBT - Numerical problems – Line Commutation and Forced Commutation circuits.

**UNIT – III SINGLE PHASE HALF CONTROLLED CONVERTERS**

Phase control technique – Single phase Line commutated converters – Mid point and Bridge connections – Half controlled converters with Resistive, RL loads and RLE load– Derivation of average load voltage and current -Active and Reactive power inputs to the converters without and with Free wheeling Diode –Numerical problems

**UNIT – IV SINGLE PHASE FULLY CONTROLLED CONVERTERS**

Fully controlled converters, Mid point and Bridge connections with Resistive, RL loads - Derivation of average load voltage and current – Line commutated inverters -Active and Reactive power inputs to the converters without and with Free wheeling Diode, Effect of source inductance – Derivation of load voltage and current – Numerical problems.



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**UNIT – V THREE PHASE LINE COMMUTATED CONVERTERS**

Three phase converters – Three pulse and six pulse converters – Mid point and bridge connections average load voltage With R and RL loads – Effect of Source inductance–Dual converters (both single phase and three phase) - Waveforms –Numerical Problems.

**UNIT – VI AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS**

AC voltage controllers – Single phase two SCR's in anti parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – Derivation of RMS load voltage, current and power factor wave forms – Firing circuits -Numerical problems -Cyclo converters – Single phase mid point cyclo converters with Resistive and inductive load (Principle of operation only) – Bridge configuration of single phase cyclo converter (Principle of operation only) – Waveforms

**UNIT – VII CHOPPERS**

Choppers – Time ratio control and Current limit control strategies – Step down choppers Derivation of load voltage and currents with R, RL and RLE loads- Step up Chopper – load voltage expression

Morgan's chopper – Jones chopper and Oscillation chopper (Principle of operation only) Waveforms — AC Chopper – Problems.

**UNIT – VIII INVERTERS**

Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter bridge inverter – Waveforms – Simple forced commutation circuits for bridge inverters – Mc Murray and Mc Murray – Bedford inverters - Voltage control techniques for inverters Pulse width modulation techniques – Numerical problems.

**TEXT BOOKS :**

1. Power Electronics – by M. D. Singh & K. B. Kanchandhani, Tata Mc Graw – Hill Publishing company, 1998.
2. Power Electronics : Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
3. Power Electronics - by V.R.Murthy , OXFORD University Press, 1st edition -2005.
4. Power Electronics-by P.C.Sen,Tata Mc Graw-Hill Publishing.



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**REFERENCE BOOKS :**

1. Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, 3rd Edition.
2. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.
3. Principles of Power Electronics by John G. Kassakian, Martin F. Schlecht and George C. Verghese, Pearson.
4. Power Electronics - Essentials & Applications by L. Umanand, Wiley India Pvt. Ltd.



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## (9A02505) ELECTRICAL MACHINES - III

**Objective :**
This subject is an extension of previous machines courses. It deals with the detailed analysis of Synchronous generators and motors which are the prime source of electrical power generation and its utilities. Also concerns about the different types of single phase motors which are having significant applications in house hold appliances and control systems.

**UNIT – I CONSTRUCTION AND PRINCIPLE OF OPERATION**
Constructional Features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors – E.M.F Equation.

**UNIT-I SYNCHRONOUS GENERATOR CHARACTERISTICS**
Harmonics in generated e.m.f. – suppression of harmonics – armature reaction - leakage reactance – synchronous reactance and impedance – experimental determination - phasor diagram – load characteristics.

**UNIT – III REGULATION OF SYNCHRONOUS GENERATOR**
Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods – salient pole alternators – two reaction analysis – experimental determination of $X_d$ and $X_q$ (Slip test) Phasor diagrams – Regulation of salient pole alternators.

**UNIT – IV PARALLEL OPERATION OF SYNCHRONOUS GENERATORS**
Synchronizing alternators with infinite bus bars – synchronizing power torque – parallel operation and load sharing - Effect of change of excitation and mechanical power input. Analysis of short circuit current wave form – determination of sub-transient, transient and steady state reactances.



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**UNIT – V SYNCHRONOUS MOTORS – PRINCIPLE OF OPERATION**

Theory of operation – phasor diagram – Variation of current and power factor with excitation – V and Inverted V Curves - Power developed – Synchronous Condenser.

**UNIT-VI POWER CIRCLES**

Excitation and power circles – hunting and its suppression – Methods of starting – synchronous induction motor.

**UNIT – VII SINGLE PHASE MOTORS**

Single phase induction motor – Constructional features - Double revolving field theory – Elementary idea of cross-field theory – split-phase motors – shaded pole motor.

**UNIT – VIII SPECIAL MOTORS**

Principle & performance of A.C. Series motor-Universal motor – Principle of permanent magnet and reluctance motors.

**TEXT BOOKS**

1. Electric Machines – by I.J.Nagrath & D.P.Kothari, Tata Mc Graw-Hill Publishers, 4th Edition, 2010.
2. Electrical Machines – by P.S. Bimbra, Khanna Publishers.

**REFERENCE BOOKS:**

1. The Performance and Design of A.C.Machines – by M.G.Say, ELBS and Ptiman & Sons.
2. Electric Machinery – by A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw-Hill Companies, 5th edition, 1990.
3. Theory of Alternating Current Machinery by Langsdorf, Tata Mc Graw-Hill, 2nd edition.
4. Electromachanics-III (Synchronous and single phase machines), S.Kamakashiah, Overseas publishers Pvt Ltd.
5. Electric Machines - by M. S. Sarma and M. K. Pathak, CENGAGE Learning.



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## (9A02506) ELECTRICAL MACHINES LAB – II

**The following experiments are required to be conducted as compulsory experiments:**

1. O.C. & S.C. Tests on Single phase Transformer
2. Sumpner's test on a pair of single phase transformers
3. Scott connection of transformers
4. No-load & Blocked rotor tests on three phase Induction motor
5. Regulation of a three –phase alternator by synchronous impedance & m.m.f. methods
6. V and Inverted V curves of a 3 phase synchronous motor.
7. Equivalent Circuit of a single phase induction motor
8. Determination of Xd and Xq of a salient pole synchronous machine

**In addition to the above eight experiments, atleast any two of the following experiments are required to be conducted from the following list:**

1. Parallel operation of Single phase Transformers
2. Separation of core losses of a single phase transformer
3. Brake test on three phase Induction Motor
4. Regulation of three-phase alternator by Z.P.F. and A.S.A methods

**TEXT BOOKS:**

1. Electrical Machines Lab manual with MATLAB Programs by Dr. D. K. Chaturvedi, University Science Press.



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## (9A02507) CONTROL SYSTEMS AND SIMULATION LAB

**Any Eight of the following experiments are to be conducted:**

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order systems
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor

**Any two simulation experiments are to be conducted:**

1. PSPICE simulation of Op-Amp based Integrator and Differentiator circuits.
2. Linear system analysis (Time domain analysis, Error analysis) using MATLAB.
3. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
4. State space model for classical transfer function using MATLAB – Verification.



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**REFERENCE BOOKS:**

1. Simulation of Electrical and electronics Circuits using PSPICE – by M.H.Rashid, M/s PHI Publications.
2. PSPICE A/D user's manual – Microsim, USA.
3. PSPICE reference guide – Microsim, USA.
4. MATLAB and its Tool Books user's manual and – Mathworks, USA.



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## (9AHS701) MANAGEMENT SCIENCE
## (Common to ECM, EEE)

**UNIT I**

**INTRODUCTION TO MANAGEMENT:**

Concepts of Management and organization- nature, importance and Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Mayo's Hawthorne Experiments, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

**UNIT II**

**DESIGNING ORGANIZATIONAL STRUCTURES:**

Basic concepts related to Organisation - Departmentation and Decentralisation, Types of mechanistic and organic structures of organisation (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organisation, Cellular Organisation, team structure, boundaryless organization, inverted pyramid structure, lean and flat organization structure) and their merits, demerits and suitability.

**UNIT III**

**OPERATIONS MANAGEMENT:**

Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement- Statistical Quality Control: chart, R chart, *c* chart, *p* chart, (simple Problems), Acceptance Sampling, Deming's contribution to quality.



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**UNIT IV**

**MATERIALS MANAGEMENT:**

Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records.

**Marketing:** Functions of Marketing, Marketing Mix, Marketing Strategies based on Product Life Cycle, Channels of distribution

**UNIT V**

**HUMAN RESOURCES MANAGEMENT (HRM):**

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs.PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

**UNIT VI**

**PROJECT MANAGEMENT (PERT/CPM):**

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

**UNIT VII**

**STRATEGIC MANAGEMENT:**

Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives.

**UNIT VIII**

**CONTEMPORARY MANAGEMENT PRACTICES:**

Basic concepts of MIS, End User Computing, Materials Requirement Planning (MRP), Just-In-Time (JIT) System, Total Quality Management (TQM), Six sigma and Capability Maturity Model (CMM) Levels, Supply Chain Management, Enterprise Resource Planning (ERP), Performance Management, Business Process outsourcing



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(BPO), Business Process Re-engineering and Bench Marking, Balanced Score Card.

**TEXT BOOKS:**

1. Aryasri: Management Science, TMH, 2004.
2. Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2004.

**REFERENCES:**

1. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2005.
2. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
3. Thomas N.Duening & John M.Ivancevich Management—Principles and Guidelines, Biztantra, 2003.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
5. Memoria & S.V.Gauker, Personnel Management, Himalaya, 25/e, 2005
6. Samuel C.Certo: Modern Management, 9/e, PHI, 2005
7. Schermerhorn, Capling, Poole & Wiesner: Management, Wiley, 2002.
8. Parnell: Strategic Management, Biztantra, 2003.
9. Lawrence R Jauch, R.Gupta &William F.Glueck: Business Policy and Strategic Management, Frank Bros., 2005.
10. L.S.Srinath: PERT/CPM,Affiliated East-West Press, 2005.



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## (9A02601) POWER SEMICONDUCTOR DRIVES

**Objective:**
This course is an extension of Power Electronics applications to AC and DC drives. Control of DC motor drives with single phase and three phase converters and choppers are given in detail. The control of AC motor drives with variable frequency converters and variable voltage are presented.

**UNIT – I CONTROL OF DC MOTORS BY SINGLE PHASE CONVERTERS**
Introduction to Thyristor controlled Drives, Single Phase semi and Fully controlled converters connected to d.c separately excited and d.c series motors – continuous current operation – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque Characteristics- Problems on Converter fed d.c motors.

**UNIT-II CONTROL OF DC MOTORS BY THREE PHASE CONVERTERS**
Three phase semi and fully controlled converters connected to d.c separately excited and d.c series motors – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque characteristics – Problems.

**UNIT – III FOUR QUADRANT OPERATION OF DC DRIVES**
Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor (Block Diagram Only)



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**UNIT-IV CONTROL OF DC MOTORS BY CHOPPERS**

Single quadrant, Two –quadrant and four quadrant chopper fed dc separately excited and series excited motors – Continuos current operation – Output voltage and current wave forms – Speed torque expressions – speed torque characteristics – Problems on Chopper fed d.c Motors – Closed Loop operation ( Block Diagram Only)

**UNIT – V CONTROL OF INDUCTION MOTOR THROUGH STATOR VOLTAGE**

Variable voltage characteristics-Control of Induction Motor by Ac Voltage Controllers – Waveforms – speed torque characteristics.

**UNIT – VI CONTROL OF INDUCTION MOTOR THROUGH STATOR FREQUENCY**

Variable frequency characteristics-Variable frequency control of induction motor by Voltage source and current source inverter and cyclo converters- PWM control – Comparison of VSI and CSI operations – Speed torque characteristics – numerical problems on induction motor drives – Closed loop operation of induction motor drives (Block Diagram Only)

**UNIT –VII CONTROL OF INDUCTION MOTOR FROM ROTOR SIDE**

Static rotor resistance control – Slip power recovery – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics – advantages - applications – problems

**UNIT – VIII CONTROL OF SYNCHRONOUS MOTORS**

Separate control & self control of synchronous motors – Operation of self controlled synchronous motors by VSI and CSI cycloconverters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications – Advantages and Numerical Problems – Closed Loop control operation of synchronous motor drives (Block Diagram Only).



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**TEXT BOOKS:**

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications
2. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI.

**REFERENCE BOOKS:**

1. Power Electronics – MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company,1998
2. Modern Power Electronics and AC Drives by B.K.Bose, PHI.
3. Thyristor Control of Electric drives – Vedam Subramanyam, Tata McGraw Hill Publilcations.
4. Analysis of Thyristor Power – conditioned motors, S K Pillai, Universities press, 1st Edition. .



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## (9A02602) POWER SYSTEM ANALYSIS

**Objective :**
This course introduces formation of Y bus and Z bus of a Power System, power flow studies by various methods. It also deals with short circuit analysis and analysis of power system for steady state and transient stability.

**UNIT -I POWER SYSTEM NETWORK MATRICES-I**
Representation of Power system elements, Essential characteristics of a good Algorithm, Steps involved in solving a problem using Digital computer - Graph Theory: Definitions, Bus Incidence Matrix, $Y_{bus}$ formation by Direct and Singular Transformation Methods, Numerical Problems.

**UNIT -II POWER SYSTEM NETWORK MATRICES-II**
Formation of $Z_{Bus}$: Partial network, Algorithm for the Modification of $Z_{Bus}$ Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses (Derivations and Numerical Problems).- Modification of $Z_{Bus}$ for the changes in network ( Problems )

**UNIT –III POWER FLOW STUDIES-I**
Necessity of Power Flow Studies – Data for Power Flow Studies – Derivation of Static load flow equations – Load flow solutions using Gauss Seidel Method: Acceleration Factor, Load flow solution with and without P-V buses, Algorithm and Flowchart. Numerical Load flow Solution for Simple Power Systems (Max. 3-Buses): Determination of Bus Voltages, Injected Active and Reactive Powers (Sample One Iteration only) and finding Line Flows/Losses for the given Bus Voltages.



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**UNIT – IV POWER FLOW STUDIES-II**

Newton Raphson Method in Rectangular and Polar Co-Ordinates Form: Load Flow Solution with or without PV Busses- Derivation of Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods.- Comparison of Different Methods – DC load Flow

**UNIT – V SHORT CIRCUIT ANALYSIS-I**

Per-Unit System of Representation. Per-Unit equivalent reactance network of a three phase Power System, Numerical Problems. Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors, Numerical Problems.

**UNIT –VI SHORT CIRCUIT ANALYSIS-II**

Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero sequence components: Voltages, Currents and Impedances. Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedance, Numerical Problems.

**UNIT –VII POWER SYSTEM STEADY STATE STABILITY ANALYSIS**

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Description of: Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability and Methods to improve steady state stability.

**UNIT –VIII POWER SYSTEM TRANSIENT STATE STABILITY ANALYSIS**

Derivation of Swing Equation. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Solution of Swing equation by $4^{th}$ order Range – Kutta Method (up to 2 iterations) - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.



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**TEXT BOOKS:**

1. Computer Methods in Power Systems, Stagg El – Abiad & Stags, Mc Graw-hill Edition.
2. Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata McGraw-Hill Publishing Company, 2nd edition.
3. Power System Analysis by Nagsarkar and Sukhija, OXFORD University Press.

**REFERENCE BOOKS:**

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Computer Techniques in Power System Analysis by M A Pai, Second Edition, TMH.
3. Power System Analysis and Design by B.R.Gupta, S. Chand & Co, 6th Revised Edition, 2010.
4. Computer Modeling of Electrical Power Systems by J. Arrillaga and N. R. Watson, John Wiley Student Edition, 2/e.
5. Computer Techniques and Models in Power Systems by K. Uma Rao, I. K. International.
6. Electric Power Systems by S. A. Nasar, Schaum's Outline Series, Revised 1st Edition, TMH.
7. Power System Analysis by Glovar and Sarma, Thomson Publishers.



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**(9A04602) MICROPROCESSORS AND MICROCONTROLLERS**
**(Common to CSE, ECE, E Con E, EIE, EEE)**

**Objective :**
The objective of this course is to introduce 8086 version of Microprocessor, and their architectural aspects and different components along with microcontroller information. .

**UNIT-I 8086 ARCHITECTURE**
Introduction to 8085 microprocessor, 8086 architecture- Functional Diagram, Register Organization,
Memory segmentation, programming model , memory addresses physical memory organization, signal descriptions of 8086- common function signals, Minimum and maximum mode signals, Timing diagrams - interrupts of 8086.

**UNIT-II INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMMING OF 8086**
Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch instructions - sorting, evaluating arithmetic expressions - string manipulations.

**UNIT-III I/O INTERFACE**
8255 PPI, Various modes of operations and interfacing to 8086, interfacing keyboard, display, stepper motor interfacing, A/D, D/A Converter Interfacing.

**UNIT-IV INTERFACING WITH ADVANCED DEVICES**
Memory interfacing to 8086 - interrupt structure of 8086. Vector interrupt table, interrupt service routine, Introduction to DOS and BIOS interrupts, interfacing interrupt controller 8259, DMA controller 8257 to 8086.

**UNIT-V COMMUNICATION INTERFACE**
Serial Communication Standards, serial data transfer schemes - 8251 USART architecture and interfacing RS-232, IEEE -488, prototype and trouble shooting.



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**UNIT-VI INTRODUCTION TO MICRO CONTROLLERS**

Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, Addressing modes and Instruction set of 8051 - Simple Programs.

**UNIT-VII REAL TIME CONTROL**

Interrupts, Timer/Counter and Serial Communication, Programming Timer Interrupts, Programming External hard ware interrupts, Programming the serial communication interrupts, Programming 8051 Timers, Counters.

**UNIT- VIII AVR RISC MICROCONTROLLER ARCHITECTURE**

Introduction, AVR family architecture, Register file, ALU, Memory access and instruction execution I/O memory EEPROM I/O ports, timers, UART, interrupt structure.

**TEXT BOOKS:**

1. D.V.Hall, "Micro Processor and Interfacing ", Tata McGraw-Hill. 2/e 2006
2. Kenneth J Ayala and Dhananjay V. Gadre, "The 8051 Micro Controller & Embedded Systems", CENGAGE learning, 2010.

**REFERENCE BOOKS:**

1. Advanced microprocessors and peripherals A.K. Ray and K M Bhurchandani TMH
2. The 8051 Micro controllers architecture and programming and applications K uma rao Andhe pallavi, pearson 2009.
3. Microcomputer Systems: The 8086/8088 Family: Architecture, Programming and Design, 2nd ed., Liu & Gibson PHI
4. "Microcontrollers and applications Ajay V. Deshmukh, Tata McGraw-Hill Companies – 2005.



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## (9A02603) POWER SYSTEM OPERATION AND CONTROL

**Objective :**
This subject deals with Economic operation of Power Systems, Hydrothermal schedulings and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

**UNIT – I ECONOMIC OPERATION OF POWER SYSTEMS-I**
Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected.

**UNIT – II ECONOMIC OPERATION OF POWER SYSTEMS-II**
Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

**UNIT – III HYDROTHERMAL SCHEDULING**
Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, Scheduling problems-Short term Hydrothermal scheduling problem.

**UNIT –IV MODELING OF TURBINE, GOVERNOR**
Modelling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models. Modelling of Governor: Mathematical Modelling of Speed Governing System – Derivation of small signal transfer function – Block Diagram.

**UNIT – V LOAD FREQUENCY CONTROL - I**
Necessity of keeping frequency constant.
Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case. Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias control



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**UNIT-VI LOAD FREQUENCY CONTROL - II**

Proportional plus Integral control of single area and its block diagram representation, steady state response – Load Frequency Control and Economic dispatch control.

**UNIT – VII REACTIVE POWER CONTROL**

Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.

**UNIT – VIII POWER SYSTEM RESTRUCTURING [4]**

Introduction – Need for Regulation – Motivation for Power System Restructuring – Key issues in Deregulation.

**TEXT BOOKS:**

1. Power System Analysis Operation and Control – A. Chakravarthi and S. Halder, 3rd Edition, PHI.
2. Modern Power System Analysis – by I.J.Nagrath & D.P.Kothari Tata M Graw – Hill Publishing Company Ltd, 2nd edition.
3. Electric Energy Systems by O I Elgerd, Mc Graw-hill Edition.
4. Electric Power Generation, Transmission and Distribution by S. N. Singh, 2nd Edition, PHI.
5. An Introduction to: Reactive Power Control and Voltage Stability in Power Transmission Systems by Abhijit Chakrabarti, D. P. Kothari, A. K. Mukhopadhyay and Abhinandan De, Eastern Economy Edition, 2010.

**REFERENCE BOOKS:**

1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., THOMPSON, 3rd Edition.
2. Electric Power Systems by S. A. Nasar, Schaum's Outline Series, Revised 1st Edition, TMH.



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## (9A10504) LINEAR & DIGITAL IC APPLICATIONS

**UNIT I**
**INTEGRATED CIRCUITS:**
Classification, chip size and circuit complexity, basic information of Opamp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

**UNIT II**
**OP-AMP APPLICATIONS:**
Basic application of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, sample & hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators, Schmitt trigger, Multivibrators, introduction to voltage regulators, features of 723.

**UNIT III**
**ACTIVE FILTERS & OSCILLATORS:**
Introduction, 1st order LPF, HPF filters. Band pass, Band reject and all pass filters. Oscillator types and principle of operation – RC, Wien and quadrature type, waveform generators – triangular, sawtooth, square wave and VCO.

**UNIT IV**
**TIMERS & PHASE LOCKED LOOPS:**
Introduction to 555 timer, functional diagram, monostable and astable operations and applications, Schmitt Trigger. PLL - introduction, block schematic, principles and description of individual blocks of 565.

**UNIT V**
**D-A AND A- D CONVERTERS:**
Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of



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ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC specifications.

**UNIT VI**

Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

**UNIT VII**

Design using TTL-74XX & CMOS 40XX series, code converters, decoders, Demultiplexers, decoders & drives for LED & LCD display. Encoder, priority Encoder, multiplexers & their applications, priority generators/checker circuits. Digital arithmetic circuits-parallel binary adder/subtractor circuits using 2's, Complement system. Digital comparator circuits.

**UNIT VIII**

**SEQUENTIAL CIRCUITS:**

Flip-flops & their conversions. Design of synchronous counters, Decade counter, shift registers & applications, familiarities with commonly available 74XX & CMOS 40XX series of IC counters.

**MEMORIES:** ROM architecture, types & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

**TEXT BOOKS:**

1. Linear Integrated Circuits –D. Roy Chowdhury, New Age International (p) Ltd, 2nd Ed., 2003.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

**REFERENCES:**

1. Operational Amplifiers & Linear Integrated Circuits – R.F. Coughlin & Fredrick F. Driscoll, PHI, 1977.



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2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
3. Design with Operational Amplifiers&Analog Integrated Circuits- Sergio Franco, McGraw Hill, 3rd Ed., 2002.
4. Digital Fundamentals – Floyd and Jain, Pearson Education, 8th Edition, 2005.



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## (9AHS601) ADVANCED ENGLISH COMMUNICATION SKILLS LAB
**(Common to ECE, E Con E, ECM, EIE, EEE, ME, AE)**

### 1. Introduction

The Advanced English Language Skills Lab introduced at the 3rd year B.Tech level is considered essential for the student for focusing on his/her career. At this stage it is imperative for the student to start preparing for the ever growing competition in the job market. In this scenario, in order to be on par with the best, he/she needs to improve his/her Communication and soft skills

This course focuses on the practical aspects of English incorporating all the four (LRSW) skills relevant to the requirements of the prospective employers in view of globalization. The proposed course will enable the students to perform the following:

- Intensive reading to improve comprehension and communication
- Attentive listening for better understanding
- Write project/research/technical reports
- Write Resume' to attract attention
- Discuss ideas / opinions for better solutions
- Face interviews confidently
- Gather information, organize ideas, and present them effectively before an audience
- To help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required ability to face computer-based competitive exams such GRE, TOEFL,CAT, GMAT etc.



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**2. Objectives:**

Keeping in mind the previous exposure of the student to English, this lab focuses on improving the student's proficiency in English at all levels. The lab intends t**o** train students to use language effectively, to participate in group discussions, to help them face interviews, and sharpen public speaking skills and enhance the confidence of the student by exposing him/her to various situations and contexts which he/she would face in his/her career

**3 Syllabus**

The following course content is prescribed for the Advanced Communication Skills Lab:

**Reading Comprehension** -- Reading for facts, guessing meanings from context, speed reading, scanning, skimming for building vocabulary(synonyms and antonyms, one word substitutes, prefixes and suffixes, idioms and phrases.)

**Listening Comprehension**-- Listening for understanding, so as to respond relevantly and appropriately to people of different backgrounds and dialects in various personal and professional situations.

**Technical Report Writing—**Types of formats and styles, subject matter, organization, clarity, coherence and style, data-collection, tools, analysis

**Resume' Writing**—Structure, format and style, planning, defining the career objective, projecting one's strengths, and skills, creative self marketing, cover letter

**Group Discussion**-- Communicating views and opinions, discussing, intervening. providing solutions on any given topic across a cross-section of individuals,(keeping an eye on modulation of voice, clarity, body language, relevance, fluency and coherence) in personal and professional lives.



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**Interview Skills**—Concept and process, pre-interview planning, mannerisms, body language, organizing, answering strategies, interview through tele and video-conferencing

**Technical Presentations (Oral)—** Collection of data, planning, preparation, type, style and format ,use of props, attracting audience, voice modulation, clarity, body language, asking queries.

**4. Minimum Requirements**

The English Language Lab shall have two parts:

The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self-study by learners.

The Communication Skills Lab with movable chairs and audio-visual aids with a P.A System, a TV, A digital stereo-audio and video system, Camcorder etc

**System Requirement (Hardware Component):**

Computer network with LAN with a minimum of 60 multimedia systems with the following specifications:

P-IV Processor, Speed-2.8 GHz, RAM_512 MB minimum, Hard Disk-80 GB, Headphones

**Prescribed Software: GLOBARENA**

**Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):**

1. **Technical writing and professional communication, Huckin and Olsen** Tata Mc Graw-Hil 2009.
2. **Speaking about Science**, A Manual for Creating Clear Presentations **by Scott Morgan and Barrett Whitener, Cambridge University press, 2006**
3. **Books on** TOEFL/GRE/GMAT/CAT/ IELTS **by Barron's/DELTA/Cambridge University Press.**
4. **Handbook for Technical Writing** by David A McMurrey & Joanne Buckely CENGAGE Learning 2008



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5. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
6. **The ACE of Soft Skills** by Gopal Ramesh and Mahadevan Ramesh, Pearson Education, 2010
7. **Cambridge English for Job-Hunting** by Colm Downes, Cambridge University Press, 2008
8. **Resume's and Interviews** by M.Ashraf Rizvi, Tata Mc Graw-Hill, 2008
9. **From Campus To Corporate** by KK Ramachandran and KK Karthick, Macmillan Publishers India Ltd, 2010
10. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
11. **Managing Soft Skills** by K R Lakshminarayan and T.Muruguvel, Sci-Tech Publications, 2010
12. **Business Communication** by John X Wang, CRC Press, Special Indian Edition,2008



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## (9A02604) ELECTRICAL MEASUREMENTS LAB

**The following experiments are required to be conducted as compulsory experiments:**

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer power factor meter
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Measurement of % ratio error and phase angle of given C.T. by comparison.
6. Schering bridge & Anderson bridge.
7. Measurement of 3 phase reactive power with single-phase wattmeter.
8. Measurement of parameters of a choke coil using 3 voltmeter and 3 ammeter methods.

**In addition to the above eight experiments, atleast any two of the experiments from the following list are required to be conducted:**

9. Optical bench – Determination of polar curve measurement of MHCP of filament lamps
10. Calibration LPF wattmeter – by Phantom testing
11. Measurement of 3 phase power with Two watt meter method (Balanced & Un balanced).
12. Dielectric oil testing using H.T. testing Kit
13. LVDT and capacitance pickup – characteristics and Calibration
14. Resistance strain gauge – strain measurements and Calibration
15. Transformer turns ratio measurement using a.c. bridge.
16. A.C. Potentiometer – Calibration of AC Voltmeter, Parameters of Choke.



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**(9A02701) DISTRIBUTION OF ELECTRIC POWER**

**UNIT – I GENERAL CONCEPTS**

Introduction to distribution systems, Load modelling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

**UNIT – II GENERAL ASPECTS OF D.C. DISTRIBUTION SYSTEMS**

Classification of Distribution Systems - Comparison of DC vs AC and Under-Ground vs Over - Head Distribution Systems- Requirements and Design features of Distribution Systems-

Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.

**UNIT III A.C. DISTRIBUTION SYSTEMS.**

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

**UNIT – IV SUBSTATIONS**

Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

Classification of substations: **Air insulated substations** - Indoor & Outdoor substations: Substations layout showing the location of all the substation equipment.

Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar Double breaker – One and half breaker system with relevant diagrams.



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**UNIT – V POWER FACTOR AND VOLTAGE CONTROL**

Causes of low p.f -Methods of Improving p.f -Phase advancing and generation of reactive KVAR using static Capacitors-Most economical p.f. for constant KW load and constant KVA type loads, Numerical Problems.

Dependency of Voltage on Reactive Power flow.- Methods of Voltage Control: Shunt Capacitors, Series Capacitors, Synchronous Capacitors, Tap changing and Booster Transformers

**UNIT – VI SYSTEM ANALYSIS**

Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

**UNIT – VII COMPENSATION FOR POWER FACTOR IMPROVEMENT**

Capacitive compensation for power-factor control - effect of shunt capacitors (Fixed and switched), Power factor correction- Economic justification - Procedure to determine the best capacitor location.

**UNIT – VIII PROTECTION AND COORDINATION OF DISTRIBUTION SYSTEMS**

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers Coordination of Protective Devices: General coordination procedure.

**TEXT BOOK:**

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, Mc Graw-hill Book Company.
2. Electric Power Distribution – by A.S. Pabla, Tata Mc Graw-hill Publishing Company, 4th edition, 1997.



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**REFERENCE BOOK:**

1. Electric Power Distribution Automation by Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press.
2. Electrical Power Distribution Systems by V. Kamaraju, Right Publishers.
3. Electrical Power Systems for Industrial Plants by Kamalesh Das, JAICO Publishing House.
4. Hand Book of Electric Power Distribution by G. Ramamurthy, 2nd Edition, Universities Press.



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## (9A04603) DIGITAL SIGNAL PROCESSING

### UNIT-I
### INTRODUCTION

Introduction to digital signal processing: discrete time signals and sequences, linear shift invariant systems, stability and causality, linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems.

### UNIT-II
### DISCRETE FOURIER SERIES

Properties of discrete Fourier series, DFS representation of periodic sequences, discrete Fourier transforms: properties of DFT, linear convolution of sequences using DFT, computation of DFT. Relation between Z-Transform and DFS.

### UNIT-III
### FAST FOURIER TRANSFORMS

Fast Fourier transforms (FFT)-Radix2 decimation in time and decimation in frequency FFT algorithms, inverse FFT and FFT for composite N.

### UNIT-IV
### REALIZATION OF DIGITAL FILTERS

Review of Z-transforms, applications of Z-Transforms, solution of difference equations of digital filters, block diagram representation of linear constant-coefficient difference equations, basic structures of IIR systems, transposed forms, basic structures of FIR systems, system function.



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**UNIT-V**
**IIR DIGITAL FILTERS**
Analog filter approximations-Butterworth and chebyshev, design of IIR digital filters from analog filters, design examples: analog-digital transformations, Illustrative Problems.

**UNIT-VI**
**FIR DIGITAL FILTERS**
Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques, frequency sampling technique, comparison of IIR and FIR filters, , Illustrative Problems.

**UNIT-VII**
**MULTIRATE DIGITAL SIGNAL PROCESSING FUNDAMENTALS:**
Basic sample rate alteration devices, Multirate Structures for sampling rate Converters, Multistage design of decimator and Interpolator, Polyphase Decomposition, Nyquist filters.

**UNIT-VIII**
**APPLICATIONS OF DIGITAL SIGNAL PROCESSING**
Spectral analysis of nonstationary Signals, Musical Sound processing, signal Compression, Transmultiplexers, Discrete Multitone Transmission of digital data.

**TEXT BOOKS:**
1. Digital signal processing, principles, Algorithms and applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education/PHI, 2007.
2. Digital signal processing , A computer base approach- Sanjit K Mitra, Tata McGraw Hill, 3rd edition, 2009.
3. Discrete Time Signal Processing-A.V. Oppenheim and R.W. Schaffer, PHI.

**REFERENCES**:
1. Digital signal processing: Andreas Antoniou, TATA McGraw Hill, 2006.



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2. A Text book on Digital Signal processing – R S Kaler, M Kulkarni, Umesh Gupta, I K International Publisthing House Pvt. Ltd.
3. Digital signal processing: M H Hayes, Schaum's outlines, TATA Mc-Graw Hill, 2007.



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## (9A02702) FUNDAMENTALS OF HVDC & FACTS DEVICES

**UNIT-I INTRODUCTION**

comparison of AC and DC Transmission systems, Application of D.C. Transmission, Types or DC links, Typical layout of a HVDC converter station. HVDC converters, pulse number, Analysis of & phase Bridge circuit with and without overlap, converter Bridge characteristics, equivalent circuits or Rectifier and inverter configurations Twelve pulse converters.

**UNIT -II CONVERTER AND HVDC SYSTEM CONTROL**

Principles of DC links control, converter control characteristics, system control Hierarchy, Firing angle control, current and extinction Angle control starting and stopping of DC link.

**UNIT -III HARMONICS, FILTERS AND REACTIVE POWER CONTROL**

Introduction, generation of Harmonics, AC and DC Filters, Reactive power requirements at steady state, sources of Reactive power static Var systems.

**UNIT -IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS**

Introduction, Modeling of DC/AC converters, controller equations, solutions of AD/DC load flow- simultaneous approach and sequential approach.

**UNIT – V FACTS CONCEPTS**

Flow of power in AC parallel paths and Meshed systems, Basic types of FACTS controllers, Brief description and Definitions of FACTS controllers.



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**UNIT - VI STATIC SHUNT COMPENSATORS**

Objectives of shunt compensation, Methods of controllable VAR generation, Static VAR compensators, SVC and STATCOM, comparison.

**UNIT - VII STATIC SERIES COMPENSATORS**

Objectives of series compensation, variable impedance type-thyristor switched series capacitors (TCSC), switching converter type series compensators – static series synchronous compensator (SSSC) – power angle characteristics – Basic operating control Schemes.

**UNIT - VIII COMBINED COMPENSATORS**

Introduction, unified power flow controller (UPFC), Basic operating principle, Independent real and reactive power flow controller, control structure.

**TEXT BOOKS:**

1. HVDC power Transmission systems by K.R. Padiyar, Wiley Eastern Limited
2. Understanding of FACTS by N.G. Hingorani & L. Gyugyi, IEEE Press.
3. Flexible AC Transmission Systems (FACTS) Young Huasong & Alian T. hons, The Institution of Electrical Engineers, IEE Power and Energy Series 30.
4. An Introduction to: Reactive Power Control and Voltage Stability in Power Transmission Systems by Abhijit Chakrabarti, D. P. Kothari, A. K. Mukhopadhyay and Abhinandan De, Eastern Economy Edition, 2010.

**REFERENCE BOOKS:**

1. **EHV - AC, HYDC Transmission & Distribution Engineering,** S.Rao,Khanna publishers, 3rd edition 2003.
2. **Power Electronic Control in Electrical Systems-** E Acha. VG Agelidis & O Anaya-Lara. THE Miller – Elsevier, 2009.



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**(9A02703) SWITCH GEAR AND PROTECTION**

**Objective:**

This course introduces all varieties of Circuit Breakers and Relays for protection of Generators, Transformers and feeder bus bars from over voltages and other hazards. It emphasis on Neutral grounding for overall protection.

**UNIT – I CIRCUIT BREAKERS-1**

Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems. – Auto reclosures.

**UNIT –II CIRCUIT BREAKERS-2**

Description and Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

**UNIT – III ELECTROMAGNETIC RELAYS**

Basic Requirements of Relays – Primary and Backup protection - Construction details of – Attracted armature, balanced beam, inductor type and differential relays – Universal Torque equation – Characteristics of over current, Direction and distance relays.

**UNIT – IV STATIC AND MICROPROCESSOR BASED RELAYS**

Static Relays – Advantages and Disadvantages – Definite time, Inverse and IDMT static relays – Comparators – Amplitude and Phase comparators. Microprocessor based relays – Advantages and Disadvantages – Block diagram for over current (Definite, Inverse and IDMT) and Distance Relays and their Flow Charts.

**UNIT – V GENERATOR PROTECTION**

Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on % Winding Unprotected.



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**UNIT –VI TRANSFORMER PROTECTION**

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz relay Protection.

**UNIT –VII PROTECTION OF FEEDERS AND TRANSMISSION LINES**

Protection of Feeder (Radial & Ring main) using over current Relays. Protection of Transmission line – 3 Zone protection using Distance Relays. Carrier current protection. Protection of Bus bars.

**UNIT – VIII PROTECTION AGAINST OVER VOLTAGES**

Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL.

**TEXT BOOKS:**

1. Switchgear and Protection – by Sunil S Rao, Khanna Publlishers
2. Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications.
3. Fundamentals of Power System Protection by Y. G. Paithankar and S. R. Bhide, 2nd Edition, PHI.

**REFERENCE BOOKS:**

1. Transmission network Protection by Y.G. Paithankar ,Taylor and Francis,2009.
2. Power system protection and switch gear by Bhuvanesh Oza, TMH, 2010.
3. Electrical Power Systems – by C.L.Wadhwa, New Age international (P) Limited, Publishers, 3nd editon
4. Electrical power System Protection by C. Christopoulos and A. Wright, 2nd Edition, Springer International Edition.



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**(9A02704) INSTRUMENTATION**
**(Elective – I)**

**Objective :**
Instrumentation is essential in monitoring and analysis of any Physical system and its control. This course deals with different types of transducers, digital voltmeters, oscilloscopes and measurement of non electrical quantities.

**UNIT-I CHARACTERISTICS OF SIGNALS**
Measuring Systems, Performance Characteristics, - Static characteristics, Dynamic Characteristics; Errors in Measurement – Gross Errors, Systematic Errors, Statistical Analysis of Random Errors.

**UNIT-II SIGNALS AND THEIR REPRESENTATION**
Signal and their representation: Standard Test, periodic, aperiodic, modulated signal, sampled data, pulse modulation and pulse code modulation

**UNIT-III DATA TRANSMISSION AND TELEMETRY**
Methods of Data Transmission – General Telemetry System – Land line Telemetry System – Voltage, Current and position. Land line with feedback system. Frequency Modulation System (FM), Pulse Modulation (PM), Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM) Telemetry. Comparison of FM, PM, PAM and PCM.

**UNIT-IV DATA ACQUISITION SYSTEM (DAS)**
Analog and Digital Acquisition systems – Components of Analog DAS – Types of Multiplexing Systems: Time division and Frequency division multiplexing – Digital DAS – Block Diagram – Use of Recorders in Digital DAS – Digital Recording using Analog Recorder – Complete data logging System - Block diagram and its working – Modern Digital DAS (Block Diagram)

**UNIT-V SIGNAL ANALYZERS**
Wave Analysers- Frequency selective analyzers, Heterodyne, Application of Wave analyzers- Harmonic Analyzers, Total Harmonic



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distortion, spectrum analyzers, Basic spectrum analyzers, spectral displays, vector impedance meter, Q meter. Peak reading and RMS voltmeters

**UNIT-VI TRANSDUCERS**

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of resistor, inductor, LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, guage factor, Thermistors, Thermocouples, Synchros, Piezo electric transducers, photovoltaic, photo conductive cells, photo diodes.

**UNIT-VII MEASUREMENT OF NON-ELECTRICAL QUANTITIES-I**

Measurement of strain, Gauge Sensitivity, Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque.

**UNIT-VIII MEASUREMENT OF NON-ELECTRICAL QUANTITIES-II**

Measurement of Temperature, Pressure, Vacuum, Flow, Liquid level.

**TEXT BOOKS:**

1. Transducers and Instrumentation by D.V.S Murthy, Prentice Hall of India
2. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co.

**REFERENCE BOOKS:**

1. Measurements Systems, Applications and Design – by D O Doeblin, Mc Graw Hill Edition.
2. Principles of Measurement and Instrumentation – by A.S Morris, Pearson /Prentice Hall of India
3. Electronic Instrumentation-by H.S.Kalsi Tata MCGraw-Hill Edition, 3/e.
4. Modern Electronic Instrumentation and Measurement techniques – by A.D Helfrick and W.D.Cooper, Pearson/Prentice Hall of India.
5. Industrial Instrumentation – Principles and Design by T. R. Padmanabhan, Springer.



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## (9A02705) HIGH VOLTAGE ENGINEERING (ELECTIVE-I)

**Objective ;**

This subject deals with the detailed analysis of Breakdown occur in gaseous, liquids and solid dielectrics. Information about generation and measurement of High voltage and current. In addition the High voltage testing methods are also discussed.

**UNIT - I INTRODUCTION**

Introduction to HV technology, need for generating high voltages in laboratory. Industrial applications of high voltage, Electrostatic precipitation, separation.

**UNIT - II BREAK DOWN IN GASEOUS AND LIQUID DIELECTRICS**

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law, Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids.

**UNIT - III BREAK DOWN IN SOLID DIELECTRICS**

Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

**UNIT – IV GENERATION OF HV AC AND DC VOLTAGE**

HV AC-HV transformer: Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit-principle of operation and advantages - Tesla coil - HV DC- voltage doubler circuit, Cockroft- Walton type high voltage DC set - Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop.



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**UNIT - V GENERATION OF IMPULSE VOLTAGE AND CURRENT:**

Introduction to standard lightning and switching impulse voltages - Analysis of single stage impulse generator-expression for Output impulse voltage - Multistage impulse generator working of Marx impulse generator, Rating of impulse generator - Components of multistage impulse generator - Triggering of impulse generator by three electrode gap arrangement - Trigatron gap and oscillograph time sweep circuits, Generation of switching impulse voltage - Generation of high impulse current.

**UNIT – VI MEASUREMENT OF HIGH VOLTAGES:**

Electrostatic voltmeter-principle, construction and limitation - Chubb and Fortescue method for HV AC measurement - Generating voltmeter-Principle, construction - Series resistance micro ammeter for HV DC measurements - Standard sphere gap measurements of HVAC, HVDC and impulse voltages - Factors affecting the measurements - Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Measurement of high impulse currents-Rogowsky coil.

**UNIT – VII NON-DESTRUCTIVE INSULATION TESTING TECHNIQUES**

Dielectric loss and loss angle measurements using Schering Bridge - Transformer ratio Arms Bridge. Need for discharge detection and PD measurements aspects - Factors affecting the discharge detection, Discharge detection methods-straight and balanced methods.

**UNIT – VIII HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS**

Definitions and terminology, tests on isolators, circuit breakers, cables, insulators and transformers.

**TEXT BOOKS:**

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 4th Edition
2. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
3. High Voltage Engineering Problems & Solutions, R. D. Begamudre, New Age International Publishers, First Edt., 2010.



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**REFERENCE BOOKS:**

1. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition.
2. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3. High Voltage Technology by L. L. Alston, OXFORD University Press, Second Edition, 2009.



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## (9A02706) RENEWABLE ENERGY SOURCES

**(Elective – I)**

**Objective :**
It introduces solar energy its radiation, collection, storage and application. It also introduces the Wind energy, Biomass energy, Geothermal energy and ocean energy as alternative energy sources.

**UNIT – I**
**PRINCIPLES OF SOLAR RADIATION**: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT-II**
**SOLAR ENERGY COLLECTION**: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT-III**
**SOLAR ENERGY STORAGE AND APPLICATIONS**: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**UNIT-IV**
**WIND ENERGY**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**UNIT-V**
**BIO-MASS**: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.



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**UNIT-VI**

**GEOTHERMAL ENERGY**: Resources, types of wells, methods of harnessing the energy, potential in India.

**UNIT-VII**

**OCEAN ENERGY**: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

**UNIT-VIII**

**DIRECT ENERGY CONVERSION**: Need for DEC, Carnot cycle, limitations, principles of DEC.

**TEXT BOOKS:**

1. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers
2. Renewable Energy Resources – Twidell & Wier, CRC Press( Taylor & Francis)

**REFERENCE BOOKS:**

1. Renewable energy resources by Tiwari and Ghosal, Narosa.
2. Renewable Energy Technologies by Ramesh & Kumar, Narosa.
3. Non-Conventional Energy Systems by K Mittal, Wheeler
4. Renewable energy sources and emerging technologies by D.P.Kothari,K.C.Singhal, PHI.



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**(9A02707) SOFT COMPUTING TECHNIQUES**
**(ELECTIVE-II)**

**Objective :**
This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components along with Genetic Algorithms. The Application of Soft Computing Techniques to Electrical Engineering is also presented.

**UNIT – I ARTIFICIAL NEURAL NETWORKS**
Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Applications of ANN.

**UNIT- II ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS**
Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

**UNIT–III SUPERVISED LEARNING NETWORKS**
Perceptron Network, Perceptron Learning Rule, Architecture, Perceptron Training Algorithm, ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, Output Layer Computation, Radial Basis Function.

**UNIT IV ASSOCIATIVE MEMORY NETWORK**
Training Algorithms for Pattern Association, Auto Associative Memory Network, Hetero Associative Memory Network, BAM, Hopfield Networks.



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**UNIT – V CLASSICAL & FUZZY SETS**

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

**UNIT VI FUZZY LOGIC SYSTEM COMPONENTS**

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**UNIT VII GENETIC ALGORITHMS**

Introduction, Basic Operators and Terminologies in GA, Traditional Vs Genetic Algorithm, Encoding, Fitness Function, Reproduction, Crossover, Mutation Operator.

**UNIT VIII APPLICATIONS TO ELECTRICAL SYSTEMS**

ANN based Short term Load Forecasting, Load flow Studies, Fuzzy logic based Unit Commitment and Genetic Algorithm based Economic Dispatch.

**TEXT BOOKS**

1. Principles of – Soft Computing by S. N. Sivanandam and S. N. Deepa, Wiley India Edition.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publications.
3. Nureal networks by Satish Kumar , TMH, 2004.
4. Neuro Fuzzy and Soft Computing by J. S. R. Jang, C. T. Sun and E. Mizutani, Pearson Education.

**REFERENCE BOOKS:**

1. Neural Networks – James A Freeman and Davis Skapura, Pearson Education, 2002.
2. Neural Networks – Simon Hakins , Pearson Education
3. Fuzzy Logic with Engineering Applications by T. J. Ross, 2nd Edition , Wiley India Edition.
4. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
5. Genetic Algorithms by D. E. Goldberg, Addison – Wisley, 1999.



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## (9A02708) RELIABILITY ENGINEERING AND APPLICATIONS TO POWER SYSTEMS

## (ELECTIVE-II)

**UNIT – I BASICS OF PROBABILITY THEORY & DISTRIBUTION**

Basic probability theory – rules for combining probabilities of events – Bernoulli's trials – probability density and distribution functions – binomial distribution – expected value and standard deviation of binomial distribution.

**UNIT – II NETWORK MODELLING AND RELIABILITY ANALYSIS**

Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.

**UNIT – III RELIABILITY FUNCTIONS**

Reliability functions f(t), F(t), R(t), h(t) and their relationships – exponential distribution – Expected value and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR, MTBF.

**UNIT – IV MARKOV MODELLING**

Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state Probabilities. – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models.



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**UNIT – V FREQUENCY & DURATION TECHNIQUES**

Frequency and duration concept – Evaluation of frequency of encountering state, mean cycletime, for one , two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states.

**UNIT – VI GENERATION SYSTEM RELIABILITY ANALYSIS**

Reliability model of a generation system– recursive relation for unit addition and removal – load modeling - Merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE, LOEE.

**UNIT – VII COMPOSITE SYSTEM RELIABILITY ANALYSIS**

System and Load Point Reliability Indices – Weather Effects on Transmission Lines, Weighted Average rate and Markov Model.

**UNIT – VIII DISTRIBUTION SYSTEM AND RELIABILITY ANALYSIS**

Basic Techniques - Radial Networks – Evaluation of Basic Reliability Indices, Performance Indices – Load Point and System Reliability Indices – Customer oriented, Loss and Energy oriented indices - Examples.

**TEXT BOOKS:**

1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007.
2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007.



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## (9A02709) OPTIMIZATION TECHNIQUES

## (ELECTIVE-II)

**UNIT – I INTRODUCTION AND CLASSICAL OPTIMIZATION TECHNIQUES**

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**UNIT – II CLASSICAL OPTIMIZATION TECHNIQUES**

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – III LINEAR PROGRAMMING**

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**UNIT – IV TRANSPORTATION PROBLEM**

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

**UNIT – V UNCONSTRAINED NONLINEAR PROGRAMMING**

One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method

**UNIT – VI UNCONSTRAINED OPTIMIZATION TECHNIQUES**

Univariate method, Powell's method and steepest descent method.



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**UNIT – VII CONSTRAINED NONLINEAR PROGRAMMING**

Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

**UNIT – VIII DYNAMIC PROGRAMMING**

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

**TEXT BOOKS:**

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. " Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer(India), Pvt .LTd.

**REFERENCE BOOKS:**

1 " Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma, Kedarnath Ramnath and company, eleventh edition, Reprint 1997.
3. "Operations Research : An Introduction" – by H.A. Taha, PHI Pvt. Ltd., 6th edition
4. Linear Programming – by G. Hadley, Narosa Publishing House, 2002



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## (9A02710) MICROPROCESSORS AND MICROCONTROLLERS LAB

### I . Microprocessor 8086:

Introduction to MASM/TASM.

Arithmetic operation – Multi byte addition and subtraction, Multiplication and Division – Signed and unsigned Arithmetic operation, ASCII – arithmetic operation.

Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.

By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison.

Modular Program: Procedure, Near and Far implementation, Recursion.

Dos/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.

### II. Interfacing

8259 – Interrrupt Controller.
8279 – Keyboard Disply.
8255 – PPI.
8251 – USART.

### III. Mcrocontroller 8051:

1. Reading and Writing on a parallel port.
2. Timer in different modes.



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3. Serial communication implementation.
4. Understanding three memory areas of 00 – FF (Programs using above areas).
5. Using external interrupts
6. Programs using special instructions like swap, bit/byte, set/reset etc.
7. Programs based on short, page, absolute addressing.



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## (9A02711) POWER ELECTRONICS AND SIMULATION LAB

**Any Eight of the Experiments in Power Electronics Lab**

1. Study of Characteristics of SCR, MOSFET & IGBT
2. Gate firing circuits for SCR's
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, and Class D & Class E)
6. DC Jones chopper with R and RL Loads
7. Single Phase Parallel, inverter with R and RL loads
8. Single Phase Cycloconverter with R and RL loads
9. Single Phase Half controlled converter with R load
10. Three Phase half controlled bridge converter with R-load
11. Single Phase series inverter with R and RL loads
12. Single Phase Bridge converter with R and RL loads
13. Single Phase dual converter with RL loads

**Any two simulation experiments with PSPICE/PSIM**

PSPICE simulation of single-phase full converter using RLE loads and single-phase AC voltage controller using RLE loads.

PSPICE simulation of resonant pulse commutation circuit and Buck chopper.

PSPICE simulation of single phase Inverter with PWM control.



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**REFERENCE BOOKS:**

1. Simulation of Electric and Electronic circuits using PSPICE – by M.H.Rashid, PHI.
2. PSPICE A/D user's manual – Microsim, USA.
3. PSPICE reference guide – Microsim, USA.
4. MATLAB and its Tool Books user's manual and – Mathworks, USA.



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## (9A02801) PRINCIPLES OF POWER QUALITY

**UNIT-I INTRODUCTION**
What is power quality? Power quality – voltage quality, why are we concerned about power quality?, the power quality Evaluation procedure, Terms and Definitions, Transients, Long-duration voltage variations, short-voltage variations, voltage imbalance, wave form distortion, voltage fluctuation, power frequency variations, power quality terms CBEMA and ITI curves.

**UNIT-II VOLTAGE SAGS AND INTERRUPTIONS**
Sources of sagas and interruptions, Estimating voltage sag performance, fundamental principles of protection, solutions at the end-use level, Motor-starting sags, utility system fault-clearing issues.

**UNIT-III TRANSIENT OVER VOLTAGES**
Sources of over voltages, principles of over voltage protection, devices for over voltage protection, utility capacitor-switching transients, utility system lightning protection.

**UNIT-IV FUNDAMENTALS OF HARMONICS**
Harmonic Distortion, Voltage versus current distortion, Harmonics versus Transients, power system qualities under non sinusoidal conditions, Harmonic indices, Harmonic sources from commercial loads, Harmonic sources from Industrial loads

**UNIT-V APPLIED HARMONICS**
Effects of Harmonics, Harmonic distortion evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion

**UNIT-VI LONG-DURATION VOLTAGE VARIATIONS**
Principles of regulating the voltage, Devices for voltage regulation, utility voltage regulator Application, capacitors for voltage regulation flicker.

**UNIT-VII POWER QUALITY BENCH MARKING**
Benchmarking process, RMS Voltage variation Indices, Harmonics indicesPower Quality Contracts



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**UNIT –VIII POWER QUALITY MONITORING**

Monitoring considerations, power quality measurement equipment, Power quality Monitoring standards

**TEXT BOOKS:**

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ptd.
2. Power quality by C. Sankaran, CRC Press

**REFERENCE BOOKS:**

1. Electrical systems quality Assessment by J. Arrillaga, N.R. Watson, S. Chen, John Wiley & Sons
2. Understanding Power quality problems by Math H. J. Bollen IEEE Press



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## (9A02802) UTILIZATION OF ELECTRICAL ENERGY

**Objective:**

It deals with the illumination, Electrical heating, Welding, Electrolytic Process and Electric Traction.

**UNIT – I ILLUMINATION**

Definition – Laws of illumination – Polar curves – Calculation of MHCP and MSCP. Lamps: Incandescent lamp, Sodium Vapour lamp, Fluorescent lamp. Requirement of good lighting scheme – Types, Design and Calculation of illumination. Street lighting and Factory lighting – Numerical Problems.

**UNIT – II ELECTRICAL HEATING**

Advantages. Methods of Electric heating – Resistance, arc, Induction and dielectric heating.

**UNIT – III ELECTRIC WELDING**

Types – Resistance, Electric arc, gas welding. Ultrasonic, Welding electrodes of various metals, Defects in welding.

**UNIT – IV ELECTROLYTIC PROCESS**

Electrolysis - Faradays laws, Application of Electrolysis, Power supply for Electrolysis.

**UNIT – V ELECTRIC DRIVES**

Advantages, Types of D. C and A. C Motors and their Characteristics – Electric Breaking. Speed Control of D. C and A. C Motors – Temperature Rise and Load Equalization – Selection of Motors for particular Drive.

**UNIT – VI ELECTRIC TRACTION – I**

Introduction – Systems of Electric Traction. Comparison between A. C and D. C Traction – Special features of Traction Motors - Methods of Electric Braking – Plugging, Rheostatic and Regenarative types.

**UNIT – VII ELECTRIC TRACTION – II**

Mechanics of train movement. Speed-time curves of different services – trapezoidal and quadrilateral, speed-time curves – Numerical Problems.

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**UNIT – VIII ELECTRIC TRACTION-III**

Calculations of tractive effort, Power, specific energy consumption - effect of varying acceleration and braking retardation, Adhesive weight and coefficient of adhesion – Problems.

**TEXT BOOK:**

1. Utilization of Electric Energy – by E. Openshaw Taylor and V. V. L. Rao, Universities Press.
2. Utilization of Electrical Power – by R. K. Rajput, Laxmi Publications.

**REFERENCE BOOKS:**

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Co.



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## (9A02803) MODERN CONTROL THEORY
## (ELECTIVE – III)

**Objective :**
This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

**UNIT – I STATE VARIABLE DESCRIPTION**
Concept of State – State Equations for Linear Continuous time Models – Non uniqueness of state model – State diagrams for continuous time state models – Solution of state equations – State transmission matrix.

**UNIT – II CONTROLLABILITY AND OBSERVABILITY**
Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability of state models in Jordan canonical form and other canonical forms.

**UNIT – III MODAL CONTROL**
Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

**UNIT – IV DESCRIBING FUNCTION ANALYSIS**
Introduction to nonlinear systems, Types of nonlinearities, Concepts of describing functions, Derivation of describing functions for Dead zone, Saturation, backlash, relay with dead zone and Hysteresis - Jump Resonance.

**UNIT-V PHASE-PLANE ANALYSIS**
Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Singular points, Phase-plane analysis of nonlinear control systems.

**UNIT-VI STABILITY ANALYSIS**
Stability in the sense of Lyapunov. Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.



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**UNIT –VII OPTIMAL CONTROL**

Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Infinite time Regulator, Output regulator problem. Tracking problem, Parameter Optimization.

**UNIT-VIII CALCULUS OF VARIATIONS**

Minimization of functionals of single function, Constrained minimization. Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints.

**TEXT BOOKS:**

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.

**REFERENCE BOOKS:**

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.



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## (9A02804) SPECIAL ELECTRICAL MACHINES
## (Elective – III)

**UNIT –I SPECIAL TYPES OF D. C. MACHINES - I**

Series booster – Shunt booster – Non – reversible booster – Reversible booster

**UNIT –II SPECIAL TYPES OF D.C. MACHINES - II**

Armature excited machines – Rosenberg generator – The Amplidyne and Metadyne - Rototrol and Regulex– Third brush generator – Three – wire generator - Dynamometer.

**UNIT –III STEPPER MOTORS**

Introduction – Synchronous Inductor (or Hybrid Stepper Motor), Hybrid Stepping Motor, Construction, Principle of Operation, Energisation with two phase at a time – Essential conditions for the satisfactory Operation of a 2 – Phase Hybrid Step Motor –Very Slow-Speed Synchronous Motor for Servo Control – Different Configurations for Switching the Phase Windings – Control Circuits for Stepping Motors – An Open – Loop Controller for a 2-Phase Stepping Motor.

**UNIT – IV VARIABLE RELUCTANCE STEPPING MOTORS**

Variable Reluctance (VR) Stepping Motors, Single – Stack VR step motors, Multiple stack VR motors – Open – Loop Control of 3-Phase VR Step Motor – Closed – Loop Control of Step Motor, Discriminator (or rotor position sensor), Translator, Major loop – Characteristics of Step Motor in Open – Loop Drive – Comparison between Open-Loop Position Control with Step Motor and a Position Control Servo using a Conventional (dc or ac) Servo Motor – Suitability and Areas of Application of Stepping Motors – 5 – Phase Hybrid Stepping Motor – Single – Phase Stepping Motor, The Construction, Operating Principle, Torque developed in the Motor.

**UNIT – V SWITCHED RELUCTANCE MOTOR**

Introduction – Improvements in the Design of Conventional reluctance Motors – Some Distinctive Differences between SR and Conventional



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Reluctance Motors – principle of Operation of SRM – Some Design Aspects of Stator and Rotor Pole Arcs, Design of stator and Rotor and pole Arcs in SR Motor, Determination of $L(\theta) - \theta$ Profile – Power Converter for SR Motor – A Numerical Example - Rotor Sensing Mechanism and Logic Control, Drive and Power Circuits, Position Sensing of rotor with Hall Problems – Derivation of Torque Expression, General, Linear Case.

**UNIT –VI PERMANENT MAGNET MATERIALS AND MOTORS**

Introduction, Hysteresis loops and recoil line – Stator Frames (Pole – and Yoke – Part) of Conventional PM dc Motors, Equivalent circuit of a PM – Development of Electronically Commutated DC Motor from Conventional DC Motor .

**UNIT –VII BRUSHLESS DC MOTOR**

Types of Construction – Principle of Operation of BLDM – Sensing and Switching Logic Scheme, Sensing, Logic Controller, Lockout Pulses – Drive and Power Circuits, Base Drive Circuit, Power Converter Circuit – Theoretical Analysis and Performance Prediction, Modeling and magnet circuit, d-q analysis of BLDM – Transient Analysis – Formulation in terms of Flux Linkages as State Variables – Approximate Solutions for Current and Torque under Steady State – Theory of BLDM as Variable Speed Synchronous Motor (Assuming Sinusoidal Flux Distribution) – Methods of reducing Torque Pulsations, $180^0$ Pole Arc and $120^0$ current sheet.

**UNIT –VIII LINEAR INDUCTION MOTOR**

Development of a Double sided LIM from Rotary type IM – A Schematic of LIM Drive for Electric Traction – Development of one sided LIM with back Iron – Field Analysis of a DSLIM: Fundamental Assumptions.

**TEXT BOOKS:**

1. K. Venkataratnam, Special Electrical Machines, University Press.
2. R. K. Rajput, Electrical machines, 4th Edition, Laxmi Publications. [For Chapters I and II refer Chapter VIII of this book]
3. V. V. Athani, Stepper Motors: Fundamentals, Applications and Design, New Age International Pub.



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4. N. Mohan, Undeland & Robbins, Power Electronics - Converters, Applications & Design, Wiley India, Student Edition.
5. Johan E. Gibson and F. B. Teuter, Control System Components, Mc Graw Hill Edition.
6. M. G. Say & E. O. Taylor, D. C. Machines, 2nd Edition, ELBS.



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## (9A02805) PLC & DCS - ITS APPLICATIONS (ELECTIVE-III)

**UNIT-I**

PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.

**UNIT-II**

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation.

**UNIT-III**

Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

**UNIT-IV**

PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

**UNIT-V**

PLC Functions: Timer functions & Industrial applications, counter function & industrial applications, Arithmetic functions, Number comparison functions, number conversion functions

**UNIT-VI**

Data Handling functions: SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions.

**UNIT-VII**

Distributed Control System (DCS) – Evolution – Different Architectures – Logical Control Unit – Operator Interface – Display – Engineering Interface.



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**UNIT-VIII**

DCS Applications to Power Plant – Iron and Steel Plants – Chemical Industries – Paper and Pulp Industries.

**Text Books**:

1. Programmable Logic Controllers by W. Bolton, 5th Edition, Elsevier, 2010
2. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI
3. Distributed Control Systems by Michal P. Lucas, Van nostrand, Reinhold Co., 1986.

**Reference Books:**

1. Programmable Logic Controllers- Programming Method and Applications –JR. Hackworth &F.D Hackworth Jr. –Pearson, 2004.
2. Distributed Computer Control of Industrial Automation by Popovic D and Bhatkar V. P, Marcel Dekkar Inc., 1990.



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**(9A02806) EMBEDDED SYSTEMS**
**(Elective – IV)**

**UNIT- I OVERVIEW OF EMBEDDED SYSTEM**
Embedded System, types of Embedded System, Requirements of Embedded System, Issues in Embedded software development, Applications.

**UNIT-II PROCESSOR & MEMORY ORGANIZATION**
Structural units in a processor, Processor selection, Memory devices, Memory selection, Memory Allocation & Map; Interfacing

**UNIT-III DEVICES & BUSES FOR DEVICE NETWORKS**
I/O devices, Timer & Counter devices, Serial Communication, Communication between devices using different buses.

**UNIT-IV DEVICE DRIVERS AND INTERRUPT SERVICING MECHANISM**
Device drives, Parallel and serial port device drives in a system, Interrupt servicing mechanism, context and periods for context switching, Deadline and Interrupt Latency.

**UNIT V PROGRAM MODELING CONCEPTS**
Program elements, Modeling Processes for Software Analysis, Programming Models, Modeling of Multiprocessor Systems.

**UNIT VI SOFTWARE ENGINEERING PRACTICES**
Software algorithm Concepts, design, implementation, testing, validating, debugging, Software Management and maintenance.

**UNIT-VII HARDWARE AND SOFTWARE CO-DESIGN**
Embedded system design and co design issues in software development, design cycle in development phase for Embedded System, Use of ICE & Software tools for development of ES, Issues in embedded system design.



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**UNIT VIII RTOS**

OS Services, I/O Sub Systems, Real Time and Embedded Systems OS, Interrupt routines in RTOS Environment, RTOS Task Scheduling Models.

**TEXT BOOKS:**

1. Embedded Systems : Architecture, Programming and Design – Rajkamal, TMH, 2003.
2. Programming for Embedded System: DreamTech Software Team-John Wiley -2002

**REFERENCES:**

1. Embedded Systems & Robots by Subrata Ghoshal, CENGAGE Learning.



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**(9A02807) DESIGN OF ELECTRICAL SYSTEMS**
**(Elective – IV)**

**UNIT – I DESIGN ASPECTS OF ELECTRICAL SYSTEMS**
Role of Statutes in Electrical System Design, Classification of Building Services, Design Aspects of Lighting, Design Aspects of Ventilation, Design Aspects of Climate Control, Design Aspects of Vertical Transportation, Design Aspects of Minor Building Services.

**UNIT – II ELECTRICAL INSTALLATIONS IN DOMESTIC BUILDINGS**
Classification, Estimation of Load Requirements, Selection of Type of Wiring, Special Features Applicable for High-Rise Apartment Buildings, Pre-commissioning Tests.

**UNIT – III INDUSTRIAL INSTALLATIONS - I**
Classification of Industrial Installation, General Characteristics, Selection of Distribution Architecture, Selection of Transformers and Sub Stations

**UNIT – IV INDUSTRIAL INSTALLATIONS - II**
Short Circuit Studies, Fault Current Calculations, Earthing Design, Selection of Switch Gears: Electrical Protection, Protection of Circuit Elements, Persons & Life stack, Equipment, Electrical Isolation, Switch Gear Control, Switching Devices, Uses, Selective Co-ordination, Circuit Breakers and Their Selection.

**UNIT – V POWER FACTOR IMPROVEMENT**
Nature of Reactive Energy, Power Factor, How to Improve Power Factor?, Economics of Power Factor Improvement, Location of Capacitors, Installation Precautions, Optimal Compensation, PF Correction of Induction Motors, Protection and Control, Voltage Transients, Switching Considerations.

**UNIT – VI POWER SYSTEM EARTHING**
Introduction, Earthing, Types of System Earthing, Reasons for Grounding/ Earthing, TN System, TT System, IT System, Protective Measures and Protective Devices in IT System, Main Characteristics of



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Earthing Systems, Selection Criteria for Earthing, Design Considerations of Earting, Measurement of Earth Resistance, Earth Leakage Protection, Neutral Earthing for Generators and Transformers.

**UNIT – VII POER QUALITY ISSUES AND RESONANCE PROBLEMS IN SYSTEMS DESIGN**

Power Quality Issues, Harmonics, Sources of Harmonics, Disturbances Caused by Harmonics, Methods to reduce the Impact of Harmonics, Design the Detuned Capacitor Bank, IEEE Standard 519-1992 and Limits.

**UNIT – VIII ENERGY ECONOMICS IN SYSTEM DESIGN**

Introduction, Time Value of Money, Single Payment Compound Amount Model (SPCA), Uniform Series Compound Amount Model (USCA), Uniform Series Present Worth Model (USPW), Depreciation, Tax Considerations, After Tax Analysis.

**TEXT BOOK:**

1. Electrical Systems Design – by M. K. Giridharan, I. K. International Publishing House Pvt. Ltd.
2. Design of Electrical Installations – by Er. V. K. Jain and Er. Amitabh Bajaj, University Science Press.



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**(9A02808) ENERGY AUDITING & DEMAND SIDE MANAGEMENT**
**(Elective – IV)**

**UNIT - I INTRODUCTION**
Energy situation – world and India, energy consumption, conservation, Codes, standards and Legislation.

**UNIT - II ENERGY AUDITING**
Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes. Measurements in energy audits, presentation of energy audit results.

**UNIT - III ENERGY EFFICIENT MOTORS**
Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

**UNIT - IV POWER FACTOR IMPROVEMENT**
Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on p.f. , p.f motor controllers.

**UNIT – V LIGHTING AND ENERGY INSTRUMENTS**
Good lighting system design and practice, lighting control ,lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's

**UNIT – VI ENERGY ECONOMIC ANALYSIS**
The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems.



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**UNIT – VII DEMAND SIDE MANAGEMENT - I**

Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning.

**UNIT – VIII DEMAND SIDE MANAGEMENT - II**

Load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs.

**TEXT BOOK:**

1. Industrial Energy Management Systems, Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York.
2. Fundamentals of Energy Engineering - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey.
3. Electrical Power distribution, A S. Pabla, TMH, 5th edition, 2004
4. Demand Side Management, Jyothi Prakash, TMH Publishers.

**REFERENCES:**

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
4. Energy management hand book by W.C.Turner, John wiley and sons
5. Energy management and good lighting practice : fuel efficiency-booklet12-EEO
6. Recent Advances in Control and Management of Energy Systems, D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai, Interline Publisher, Bangalore, 1993.
7. Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern, 2005.
8. Hand book on energy auditing - TERI (Tata Energy Research Institute)



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